

CLAIMS

What is claimed is:

1. A dual damascene structure for electrically interconnection to a base metal interconnect structure formed in a semiconductor substrate, which comprises:

5 a first dielectric layer formed from a first low-K organic dielectric material selected from a group consisting essentially of Flare, SILK, BCB and Parylene, over the substrate to cover the exposed surface of the base metal interconnect structure;

an etch-stop layer formed from a low-K inorganic dielectric material selected from a group consisting essentially of fluorosilicate glass, fluorosilicon oxide, and hydrogen silsesquioxane, over the first dielectric layer;

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a second dielectric layer formed from a second low-K organic dielectric material selected from a group consisting essentially of Flare, SILK, BCB and Parylene, over the etch-stop layer;

a protective layer formed between the etch-stop and the second dielectric layer, wherein the protective layer is formed from an inorganic dielectric material having a dielectric constant K which is higher than the etch-stop layer;

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a metal line formed in the second dielectric layer and the protective layer; and

a metal plug connected with the metal line and penetrating successively through the etch-stop layer and the first dielectric layer to come into electrical contact with the base metal interconnect structure in the substrate.

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2. The dual damascene structure of claim 1, wherein the first and second organic dielectric materials used to form the first and second dielectric layers are each Flare.

3. The dual damascene structure of claim 1, wherein the first and second organic dielectric materials used to form the first and second dielectric layers are each SILK.

4. The dual damascene structure of claim 1, wherein the first and second organic dielectric materials used to form the first and second dielectric layers are each Parylene.

5. The dual damascene structure of claim 1, wherein the first and second organic dielectric materials used to form the first and second dielectric layers are each BCB.

5 6. The dual damascene structure of claim 1, wherein the protective layer is formed from silicon oxide.

7. The dual damascene structure of claim 1, wherein the protective layer is formed from silicon oxy-nitride.

8. The dual damascene structure of claim 1, wherein the protective layer is formed
10 from silicon nitride.

9. The dual damascene structure of claim 1, further comprising a hard mask layer formed over the second dielectric layer, but not covering the metal line..

10. The dual damascene structure of claim 9, wherein the hard mask layer is formed from silicon oxide.

15 11. The dual damascene structure of claim 9, wherein the hard mask layer is formed from silicon oxy-nitride.

12. The dual damascene structure of claim 9, wherein the hard mask layer is formed from silicon nitride.

13. A dual damascene structure for electrically interconnection to a base metal inter-
20 connect structure formed in a semiconductor substrate, which comprises:

a first dielectric layer formed from a first low-K inorganic dielectric material over the substrate to cover the exposed surface of the base metal interconnect structure;

an etch-stop layer formed from a low-K organic dielectric material over the first dielectric layer;

a second dielectric layer formed from a second low-K inorganic dielectric material over the etch-stop layer;

a metal line formed in the second dielectric layer and the protective layer; and

metal plug connected with the metal line and penetrating through the etch-stop layer and the first dielectric layer to come into electrical contact with the base metal interconnect structure in the substrate.

14. The dual damascene structure of claim 13, wherein the organic dielectric material used to form the etch-stop layer selected from a group consisting essentially of Flare, SILK, BCB and Parylene.

10 15. The dual damascene structure of claim 13, wherein the first and second inorganic dielectric materials used to form the first and second dielectric layers are selected from a group consisting essentially of each fluorosilicate glass (FSG), fluorosilicon oxide, and hydrogen silsesquioxane.

16. The dual damascene structure of claim 13, further comprising:
15 a protective layer formed between the etch-stop layer and the second dielectric layer.

17. The dual damascene structure of claim 16, wherein the protective layer is formed from silicon oxide.

18. The dual damascene structure of claim 16, wherein the protective layer is formed
20 from silicon oxy-nitrid.

19. The dual damascene structure of claim 16, wherein the protective layer is formed from silicon nitride.

20. A dual damascene structure for electrically interconnection to a base metal interconnect structure formed in a semiconductor substrate, which comprises:

a first dielectric layer formed from a low-K organic dielectric material selected from a group consisting essentially of Flare, SILK, BCB and Parylene, over the substrate to cover the exposed surface of the base metal interconnect structure;

5 an etch-stop layer formed from a low-K inorganic dielectric material selected from a group consisting essentially of fluorosilicate glass, fluorosilicon oxide, and hydrogen silsesquioxane, over the first dielectric layer;

a second dielectric layer formed from a low-K organic dielectric material selected from a group consisting essentially of Flare, SILK, BCB and Parylene, over the etch-stop layer;

10 a hard mask layer formed over the second dielectric layer;

a protective layer formed between the etch-stop and the second dielectric layer, wherein the dielectric constant K of the protective layer and the dielectric constant K of the etch-stop layer are different, and the protective layer includes an inorganic dielectric material selected from a group consisting essentially of silicon oxide, silicon oxy-nitride and silicon nitride;

15 a metal line formed in the hard mask layer, the second dielectric layer and the protective layer; and

metal plug connected with the metal line and penetrating through the etch-stop layer and the first dielectric layer to come into electrical contact with the base metal interconnect structure in the substrate.

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